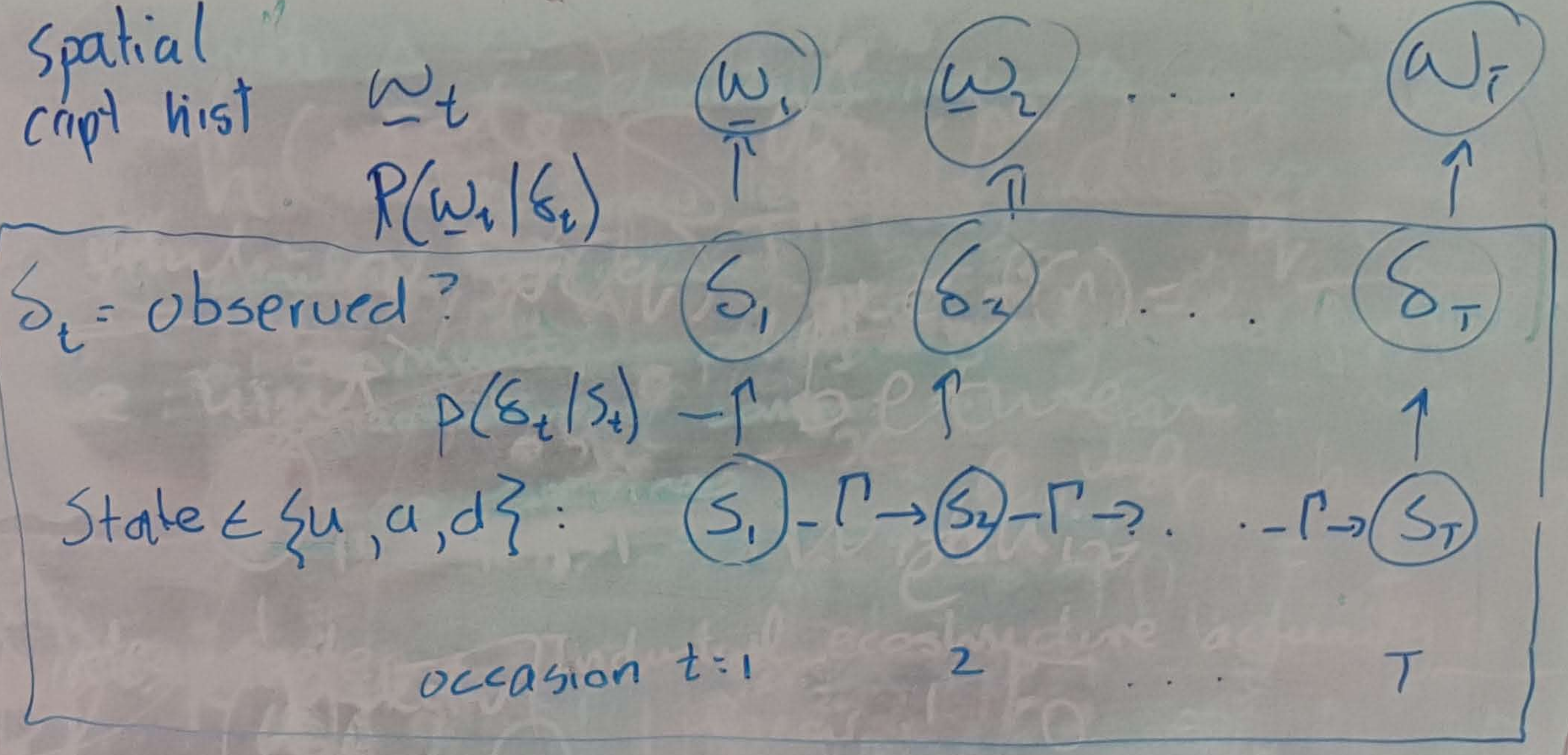
$$
\Gamma = \begin{array}{c} \\ \text{unborn} \\ \text{alive} \\ \text{dead} \end{array}
\begin{array}{c} \begin{array}{ccc} u & a & d \end{array} \\
\begin{bmatrix} 1-\beta & \beta & 0 \\ 0 & \phi & 1-\phi \\ 0 & 0 & 1 \end{bmatrix}
\end{array}
$$



$$
P = \begin{bmatrix} 1-\delta & 0 & 0 \\ 0 & \boxed{P_a} & 0 \\ 0 & 0 & 1-\delta \end{bmatrix}
$$

$$
\prod_{i=1}^{N} \mathbb{P}(\underline{\omega}_i)
$$

$$
\mathbb{P}(\text{unseen}) = \mathbb{P}(\text{unseen, alive}) + \mathbb{P}(\text{unseen, unborn})
$$

$$
P(\underline{\omega}_{it} \mid \delta_{it} = 1) = \frac{\prod_{j=1}^{J} \overbrace{P(n_{ij} \mid \underline{x}_i \ldots)}^{\text{Poisson}(\lambda(d_{ij}))}}{1 - \prod_{j^*} P(n_{ij^*} = 0 \mid \underline{x}_i)} = \frac{\prod_j P(n_{ij} \mid \underline{x}_i)}{p_\cdot(\underline{x}_i)}
$$

$$
\boxed{P_a} = P(\delta \mid s_t = a, \underline{x}) = p_\cdot(\underline{x})^{\delta} (1 - p_\cdot(\underline{x}))^{1-\delta}
$$

$$
P(\delta = 0 \mid s_t \in \{u, d\}) = 1
$$